Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2241135 C 2002/05/28

(11)(21) 2 241 135

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1996/10/28
(87) Date publication PCT/PCT Publication Date: 1997/07/03
(45) Date de délivrance/Issue Date: 2002/05/28
(85) Entrée phase nationale/National Entry: 1998/06/19
(86) N° demande PCT/PCT Application No.: US 1996/017509
(87) N° publication PCT/PCT Publication No.: 1997/023751
(30) Priorité/Priority: 1995/12/22 (08/577,610) US

(51) Cl.Int.^{6}/Int.Cl.^{6} F23D 1/00

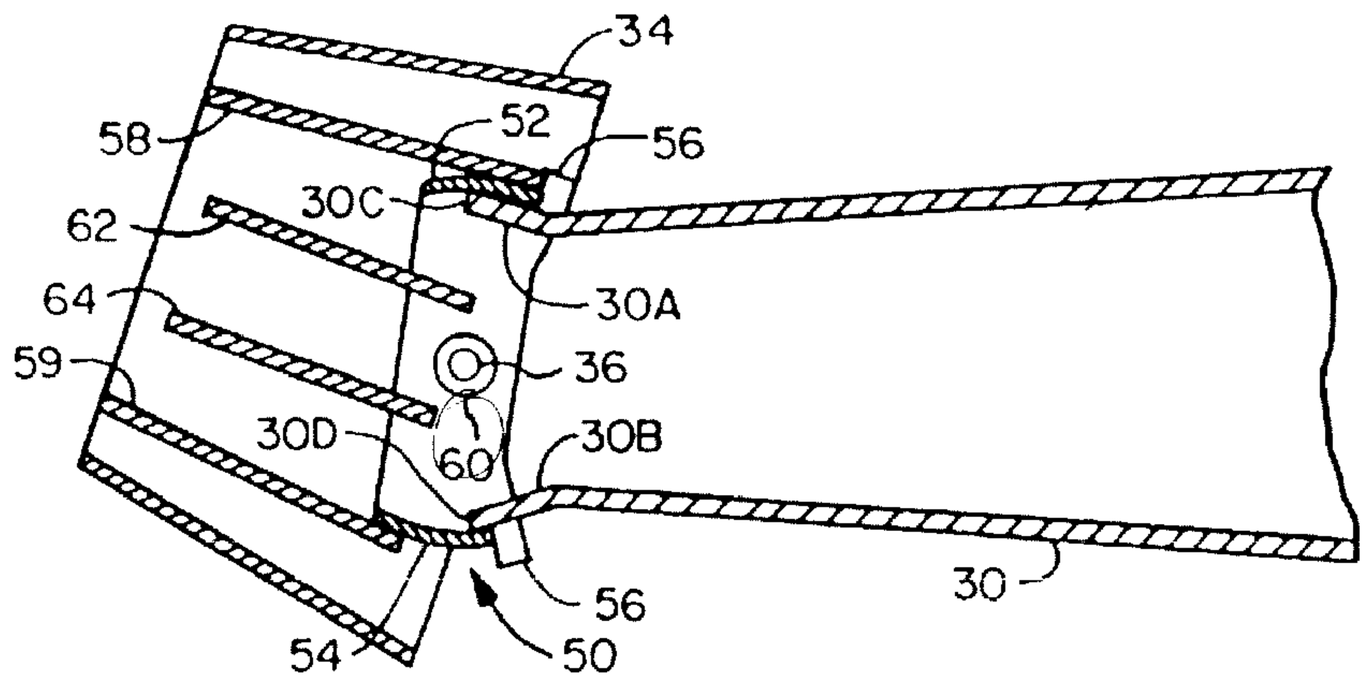
(72) Inventeur/Inventor:
MANN, Jeffrey Scott, US

(73) Propriétaire/Owner:
ALSTOM POWER INC., US

(74) Agent: SMART & BIGGAR

(54) Titre : ENSEMBLE AJUTAGE POUR CHARBON A COUCHE BARRIERE DESTINE A UN APPAREIL GENERATEUR DE VAPEUR

(54) Title: BOUNDARY LAYER COAL NOZZLE ASSEMBLY FOR STEAM GENERATION APPARATUS



(57) Abrégé/Abstract:
A steam generating system (10) includes a nozzle for pulverized coal and air which includes an elongated generally cylindrical body (30) having a nozzle at one axial portion thereof. The apparatus also includes a nozzle tip (34) that is generally sleeve shaped and dimensioned to overlap an extremity of the body (30). The tip (34) is mounted for pivotal movement about the extremity of the body (30) and the nozzle tip (34) includes first and second surfaces (58, 59) dimensioned and configured for receiving therebetween all flow from the nozzle body (30). The apparatus also includes a seal plate (50) that is also generally sleeve shaped and dimensioned and configured to provide sealing between the extremity and the nozzle tip (34). The seal plate (50) is mounted for pivotal movement about the extremity of the body (30) and is dimensioned and configured to have third and fourth surfaces (52, 54) disposed respectively in closely spaced relationship to the first and second surfaces (58, 59) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34). This closely spaced relationship defines an elongated slot for passage of air. The seal plate (50) includes a stop (56) to limit relative pivotal motion between the nozzle tip (34) and the seal plate (50). In some forms of the invention the first and second surfaces (58, 59) are planar surfaces. The third and fourth surfaces (52, 54) may be cylindrical sections. The stop (56) may include at least one upstanding member carried on the seal plate (50). The seal plate (50) may include first and second planar opposed sides joined by the third and fourth surfaces (52, 54). In some forms of the invention the third and fourth surfaces (52, 54) have concave parts and the concave parts are disposed in opposed relationship. The stop (56) may be a part of the first and second planar opposed sides and may include at least one ear on each of the first and second sides and in some cases also include a second ear on each of the first and second sides. All of the ears may be generally planar and each of the ears may be coplanar with one of the sides.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : F23D 1/00	A1	(11) International Publication Number: WO 97/23751
		(43) International Publication Date: 3 July 1997 (03.07.97)

(21) International Application Number: PCT/US96/17509

(22) International Filing Date: 28 October 1996 (28.10.96)

(30) Priority Data:
08/577,610 22 December 1995 (22.12.95) US

(71) Applicant: COMBUSTION ENGINEERING, INC. [US/US]; 1000 Prospect Hill Road, Windsor, CT 06095 (US).

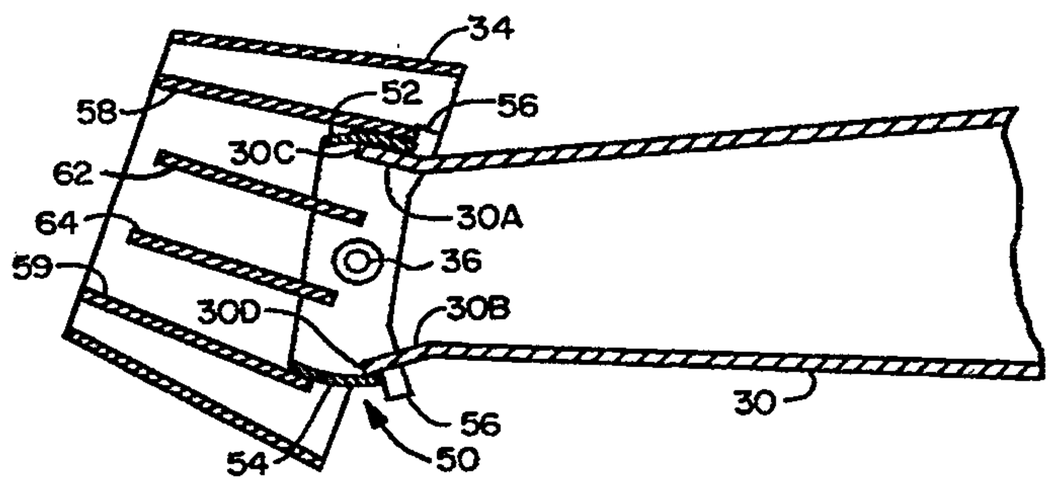
(72) Inventor: MANN, Jeffrey, S.; Apartment F-33, Mill Pond Road, Broad Brook, CT 06016 (US).

(74) Agents: FOURNIER, Arthur, E., Jr. et al.; Combustion Engineering, Inc., Patent Services 4540-0426, 2000 Day Hill Road, Windsor, CT 06095 (US).

(81) Designated States: AU, CA, CN, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: BOUNDARY LAYER COAL NOZZLE ASSEMBLY FOR STEAM GENERATION APPARATUS



(57) Abstract

A steam generating system (10) includes a nozzle for pulverized coal and air which includes an elongated generally cylindrical body (30) having a nozzle at one axial portion thereof. The apparatus also includes a nozzle tip (34) that is generally sleeve shaped and dimensioned to overlap an extremity of the body (30). The tip (34) is mounted for pivotal movement about the extremity of the body (30) and the nozzle tip (34) includes first and second surfaces (58, 59) dimensioned and configured for receiving therebetween all flow from the nozzle body (30). The apparatus also includes a seal plate (50) that is also generally sleeve shaped and dimensioned and configured to provide sealing between the extremity and the nozzle tip (34). The seal plate (50) is mounted for pivotal movement about the extremity of the body (30) and is dimensioned and configured to have third and fourth surfaces (52, 54) disposed respectively in closely spaced relationship to the first and second surfaces (58, 59) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34). This closely spaced relationship defines an elongated slot for passage of air. The seal plate (50) includes a stop (56) to limit relative pivotal motion between the nozzle tip (34) and the seal plate (50). In some forms of the invention the first and second surfaces (58, 59) are planar surfaces. The third and fourth surfaces (52, 54) may be cylindrical sections. The stop (56) may include at least one upstanding member carried on the seal plate (50). The seal plate (50) may include first and second planar opposed sides joined by the third and fourth surfaces (52, 54). In some forms of the invention the third and fourth surfaces (52, 54) have concave parts and the concave parts are disposed in opposed relationship. The stop (56) may be a part of the first and second planar opposed sides and may include at least one ear on each of the first and second sides and in some cases also include a second ear on each of the first and second sides. All of the ears may be generally planar and each of the ears may be coplanar with one of the sides.

BOUNDARY LAYER COAL NOZZLE ASSEMBLY FOR STEAM GENERATION APPARATUS

The invention relates to coal delivery systems for delivering pulverized coal to coal fired steam generators and more particularly to the construction of the nozzle for delivering the coal. Coal fired furnaces are typically provided with a plurality of ducts or pipes through which pulverized coal is directed to a plurality of fuel-air admission assemblies arrayed in respective vertically extending windboxes. The windboxes are disposed in one or more walls of the furnace and each introduces coal and air into the furnace. The design of such nozzles must consider that the nozzles may be exposed to temperatures well over 1500 degrees Fahrenheit.

The prior art also includes apparatus such as shown in United States Patent 5,435,492 for a modular coal nozzle assembly for vapor generation apparatus issued to Ronald J. Tenerowicz and having the same assignee as the present application.

Known nozzle constructions are vulnerable to structural distortion resulting from radiant heat when left out of service for long periods of time. For example, if the the furnace operates at less than peak capacity, not all of the nozzles will function. The nozzles that are not operating are subject to distortion caused by the radiant heat from the furnace. The known nozzle constructions are also vulnerable to structural distortion when coal ignition occurs inside the tip of the coal nozzle. The structural distortion typically results from temperature differentials in the parts of the nozzle caused by radiation of heat generated by combustion within the nozzle.

In Document US-A-2 895 435 there is disclosed one such known nozzle construction. More specifically, Document US-A-2 895 435 discloses a nozzle apparatus for use with an associated steam generating system. This nozzle comprises an elongated generally cylindrical body 3 having a nozzle at one axial portion thereof; a nozzle tip, said tip being generally sleeve shaped and being dimensioned to overlap an extremity of said body, said tip being mounted for pivotal movement about said extremity of said body, said nozzle tip including first and second surfaces 5 dimensioned and configured for receiving therebetween all flow from said nozzle body; and a seal plate, said seal plate generally sleeve shaped and dimensioned and configured to provide sealing between said extremity and said nozzle tip, said seal plate being mounted for pivotal movement about said extremity of said body, said seal plate being dimensioned and configured to have third and fourth surfaces 8 thereof disposed respectively in closely spaced relationship to said first and second surfaces throughout all possible pivotal positions of said seal plate and said nozzle tip, said seal plate including a stop (see the end of the arrow of reference sign 8) to limit relative pivotal motion between said nozzle tip and said seal plate.

The problems related to the temperatures around the nozzle are most acute in so called flame attachment nozzles that intentionally maintain the flame near to the nozzle. The problems caused by the high temperatures are also more acute when firing high sulfur and/or high iron content fuels. More specifically, coals having a sulfur content of 1.5% or greater and/or iron outside levels of 10% or greater are particularly a problem. The problems are also accentuated under marginal transport conditions. Such conditions occur, for example, when the hot air fan is too small, the tempering air duct is too small, the mill is not large enough, or the system is operating at high elevations.

When firing high sulfur content and/or high iron content coal under marginal transport conditions, low pressure zones occur at the tip area that results in plane retention of by a fuel and ash buildup. More specifically, the phenomenon known as "plating out" occurs with increasing temperature above the softening temperature of the coal. Thus,

continued operation under such conditions leads to distortion of the tip. This distortion affects nozzle performance and service life.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide apparatus which will avoid nozzle tip distortions that occur in prior art nozzle constructions.

Another object of the invention is to provide apparatus that will function satisfactorily even with coals having a substantial sulfur and/or iron oxide content.

Still another object of the invention is to provide apparatus that will shield the nozzle tip from the effects of the temperatures present at the nozzle tips.

Yet another object of the invention is to provide apparatus that will sweep away any deposits of slag or ash which may have been deposited inside the nozzle when the nozzle is out of service.

Another object of the invention is to provide apparatus that will be less expensive to manufacture than prior art structures.

According to the invention there is provided a coal feed nozzle for use with an associated steam generating system (10) including an elongated generally cylindrical body (30), a generally sleeved shape nozzle tip (34) disposed in overlapping relationship with an extremity (30a, 30b) of the body (30), the nozzle tip (34) being mounted for pivotal movement (36) about the extremity (30a, 30b) of the body (30) and including first (58) and second (59) surfaces for guiding therebetween flow from the body (30), and a generally sleeve shaped seal plate (50) disposed in sealing relationship between the extremity (30a, 30b) and the nozzle tip (34), the seal plate (50) being mounted for pivotal movement (36) about the extremity (30a, 30b) of the body (30) and including a stop (56) to limit relative pivotal motion between the nozzle tip (34) and the seal plate (50), the coal feed nozzle being characterized in that: a. the seal plate (50) has a third (52) surface thereof disposed in spaced relationship to the first surface (58) of the nozzle tip (34) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34) and a fourth (54) surface thereof disposed in spaced relationship to the second surface (59) of the nozzle tip (34) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34); b. the seal plate (50) includes first and second planar opposed sides (62) joined by said third (52) and fourth (54) surfaces; and c. the stop (56) includes a first ear (56) at one axial extremity of the third surface (52) of the seal plate (50), a second ear (56) at the other axial extremity of the third surface (52) of the seal plate (50), a

first ear (56) at one axial extremity of the fourth surface (54) of the seal plate (50), and a second ear (56) at the other axial extremity of the fourth surface (54) of the seal plate (50), each ear (56) being coplanar with a respective one of the first and second planar opposed sides (62), the third surface (52) of the seal plate (50), the first ear (56) and the second ear (56) at the axial extremities of the third surface (52) of the seal plate (50), the first surface (58) of the nozzle tip (34) together defining a slot through which secondary air flows and the fourth surface (54) of the seal plate (50), the first ear (56) and the second ear (56) at the axial extremities of the fourth surface (54) surface of the seal plate (50), and the second surface (59) of the nozzle tip (34) together defining a slot through which secondary air flows.

In some forms of the invention the first and second surfaces are planar surfaces. The third and fourth surfaces may be cylindrical sections.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood by reference to the accompanying drawing in which:

Figure 1 is a vertical sectional view of a steam generation apparatus of a type in which the present invention has application.

Figure 2 is a front view of a prior art seal plate.

Figure 3 is a plan view of the prior art seal plate shown in Figure 2.

Figure 4 is a side view of the prior art seal plate shown in Figure 2.

Figure 5 is a front view of the seal plate in accordance with one form of the present invention.

Figure 6 is a plan view of the seal plate shown in Figure 5.

Figure 7 is a side view of the seal plate shown in Figure 5.

Figure 8 is a sectional view taken along a vertical plane illustrating the relationship of the parts in a nozzle when the nozzle has traveled to the maximum upward position.

Figure 9 is a sectional view taken along a vertical plane illustrating the relationship of the parts in a nozzle when the nozzle has traveled to the maximum downward position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Figure 1 there is shown a furnace 10 that is a type of furnace with which the present invention may be utilized. The furnace 10 is vertically disposed and has an outlet for combustion gases that it's upper end. Extending from this outlet is a lateral gas pass 12 which connects with the upper end of a vertically extended gas pass 14 and a stack (not shown). The illustrated furnace 10 is provided with a burner 16. The furnace 10 has a front wall 22 and a rear

wall 24. Side walls (not shown) are disposed in spaced relationship and joined the front wall 22 and the rear wall 24.

As best seen in Figures 8 and 9 it is conventional for a coal nozzle to have an elongated body 30 which carries a mobile tip 34 mounted for rotatable movement about a pin 36. Typically, the tip 34 is movable between plus or minus twenty-five degrees up or down from an aligned or coaxial relationship between the tip 34 and the body 30. Disposed intermediate the tip 34 and the body 30 is a seal plate. The seal plate 50 in accordance one form of the present invention is shown in Figures 5-9. The seal plate 50 seals the nozzle body 30 with respect to the nozzle tip 34 as the nozzle tip moves throughout the possible range of travel as illustrated in Figures 8 and 9.

The nozzle body 30 is provided with an upper horizontal flange 30A and a lower horizontal flange 30B that extend respectively upwardly and downwardly from the body 30. More specifically, the flanges 30A and 30B are diverging generally planar surfaces that are spaced apart from opposite sides of a horizontal plane (not shown) that bisects the body 30. The seal plate 50 includes a first cylindrical section shaped surface 52 and a second cylindrical section shaped surface 54. These surfaces respectively mesh with the free edges 30C, 30D of the flanges 30A and 30B to provide sealing.

A pin 36 supported by a bracket (not shown) attached to the body 30 carries both the nozzle tip 34 and the seal plate 50 for pivotal movement. More particularly, as best seen in Figures 8 and 9, the nozzle tip 34 is generally rectangular although the tip may be cylindrical or square in other embodiments. Disposed within the nozzle tip 34 are two generally planar plates 58, 59 that are disposed in closely spaced, substantially tangential relationship to the outer faces respectively of the cylindrical section shaped surfaces 52, 54. More specifically, the plates 58, 59 are respectively spaced about two inches from the cylindrical surfaces 52, 54. This spacing is sufficient to substantially prevent the pulverized coal flowing through the body 30 from passing between the plates 58, 59 and respectively the cylindrical surfaces 52, 54. Accordingly, fluid flow through the body 30 is directed out the tip 34 through only the part of the tip 34 that is intermediate the plates 58, 59. Additional parallel plates 62, 64 are

disposed in spaced parallel relationship about the geometric axis of the tip 34. The plates 62, 64 serve to direct the flow through the tip 34 and promote laminar flow.

In operation the nozzle tip 34 is positioned by conventional mechanism (not shown) to a plurality of angular positions throughout the possible 50 degree range of movement thereof. The choice of position is determined by the requirements for optimum combustion. Primary air and coal are forced through the body 30, the central part of the seal plate 52, and the portion of the nozzle tip 34 that is intermediate the plates 58, 59. Secondary air is directed along the exterior surface of the body 30 (1) into the portion of the nozzle tip 34 that is outside the plates 58, 59 and (2) into the two inch high slots intermediate the plates 58, 59 and the seal plate 52. It will be understood that each of the two inch high slot extends the width of the nozzle tip 34. For many applications it will be desirable to direct the secondary air at a higher velocity than the primary air that passes through the body 30. This velocity relationship aids in preventing flame retention when the secondary air is flowing at a velocity greater than the flame propagation velocity. The direction of the secondary air into the slots produces a boundary layer of air on the inner face of the plates 58, 59 which protects these plates from erosion resulting from the massive quantities of pulverized coal that are directed through the nozzle tip 34.

In the preferred embodiment the seal plate 50 is provided with first and second ears at the axial extremities of the cylindrical section shaped surface 52. In addition the seal plate 50 is also provided with first and second ears at the axial extremities of the cylindrical section shaped surface 54. The illustrated preferred embodiment includes generally planar ears or ear shaped stop member 56. Those skilled in the art will recognize that in other embodiments of the invention the stop members may be L-shaped pieces, round pegs, square blocks or any of numerous other shapes.

Figure 8 illustrates the nozzle tip 34 disposed to direct flow in the maximum upward position. It will be seen that secondary flow directed axially along the exterior surface of the body 30 passes into the regions respectively inside of the plates 58, 59 disposed inside the nozzle tip 34. The spaced ears 56 cause

essentially no impediment to flow of secondary air along the outer surface of the body 30 and (1) into the portion of the nozzle tip 34 that is outside the plates 58, 59 and (2) into the two inch high slots intermediate the plates 58, 59 and the seal plate 52.

As is apparent from Figure 8, the ears 56, 56 at the axial extremities of the cylindrical section shaped surface 52 abut the edge of the plate 58 when the nozzle tip 34 is rotated to the maximum up position. It will thus be seen that the mechanism (not shown) that causes rotation of the nozzle tip 34 causes the seal plate to travel along the flange 30A until the edge of the seal plate reaches the throat of the body 30. The travel of the seal plate 50 is, of course, a rotation about the pin 36 which engages the aligned holes 60, 60 in the respective side walls 61, 61 thereof.

Figure 9 shows the corresponding engagement between the edge of the plate 59 and the ears 56 disposed at the axial extremities of the cylindrical section shaped surface 54 when the nozzle tip 34 is positioned to direct flow in the maximum downward position.

The present invention is seemingly a small change from the prior art shown in Figures 2-4. However, the change produces a very import benefit. The seal plate 40 differs from the seal plate 50 in that the latter does not include the ears 56. Instead the structure has laterally extending lips 42 extending along one edge of respective the cylindrical section shaped surface 52 and the cylindrical section shaped surface 54. These lips 42, 42 have now been found to obstruct the flow of secondary air along the outer surface of the body 30 and thus do not produce the results that are achieved with the apparatus in accordance with the present invention. Advantageously, the apparatus in accordance with the present invention may be manufactured more inexpensively than the prior art apparatus illustrated in Figures 2-4. This follows because the structure of the present invention requires less material and requires less fabrication time and expense.

A particular advantage of the present invention is that no changes need to be made to the prior art nozzle tip 34 to achieve the beneficial results of the present

invention. Thus the present invention may be retrofitted easily on existing equipment and future production may be easily modified. The present invention advantageously produces a boundary layer that protects the nozzle structure both from heat as well as the erosion caused by the tons of pulverized coal that passes through such apparatus.

The invention has been described with reference to its illustrated preferred embodiment. Persons skilled in the art of such devices may upon disclosure to the teachings herein, conceive other variations. Such variations are deemed to be encompassed by the disclosure, the invention being delimited only by the following claims.

CLAIMS:

1. A coal feed nozzle for use with an associated steam generating system (10) including an elongated generally cylindrical body (30), a generally sleeved shape nozzle tip (34) disposed in overlapping relationship with an extremity (30a, 30b) of the body (30), the nozzle tip (34) being mounted for pivotal movement (36) about the extremity (30a, 30b) of the body (30) and including first (58) and second (59) surfaces for guiding therebetween flow from the body (30), and a generally sleeve shaped seal plate (50) disposed in sealing relationship between the extremity (30a, 30b) and the nozzle tip (34), the seal plate (50) being mounted for pivotal movement (36) about the extremity (30a, 30b) of the body (30) and including a stop (56) to limit relative pivotal motion between the nozzle tip (34) and the seal plate (50), the coal feed nozzle being characterized in that:

a. the seal plate (50) has a third (52) surface thereof disposed in spaced relationship to the first surface (58) of the nozzle tip (34) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34) and a fourth (54) surface thereof disposed in spaced relationship to the second surface (59) of the nozzle tip (34) throughout all possible pivotal positions of the seal plate (50) and the nozzle tip (34);

b. the seal plate (50) includes first and second planar opposed sides (62) joined by said third (52) and fourth (54) surfaces; and

c. the stop (56) includes a first ear (56) at one axial extremity of the third surface (52) of the seal plate (50), a second ear (56) at the other axial extremity of the

third surface (52) of the seal plate (50), a first ear (56) at one axial extremity of the fourth surface (54) of the seal plate (50), and a second ear (56) at the other axial extremity of the fourth surface (54) of the seal plate (50), each ear (56) being coplanar with a respective one of the first and second planar opposed sides (62), the third surface (52) of the seal plate (50), the first ear (56) and the second ear (56) at the axial extremities of the third surface (52) of the seal plate (50), the first surface (58) of the nozzle tip (34) together defining a slot through which secondary air flows and the fourth surface (54) of the seal plate (50), the first ear (56) and the second ear (56) at the axial extremities of the fourth surface (54) surface of the seal plate (50), and the second surface (59) of the nozzle tip (34) together defining a slot through which secondary air flows.

2. A coal feed nozzle according to claim 1 wherein the first surface (58) and the second surface (59) of the nozzle tip (34) are planar surfaces.

3. A coal feed nozzle according to claim 1 wherein the third surface (52) and the fourth surface (54) of the seal plate (50) are cylindrical sections.

SMART & BIGGAR

OTTAWA, CANADA

PATENT AGENTS

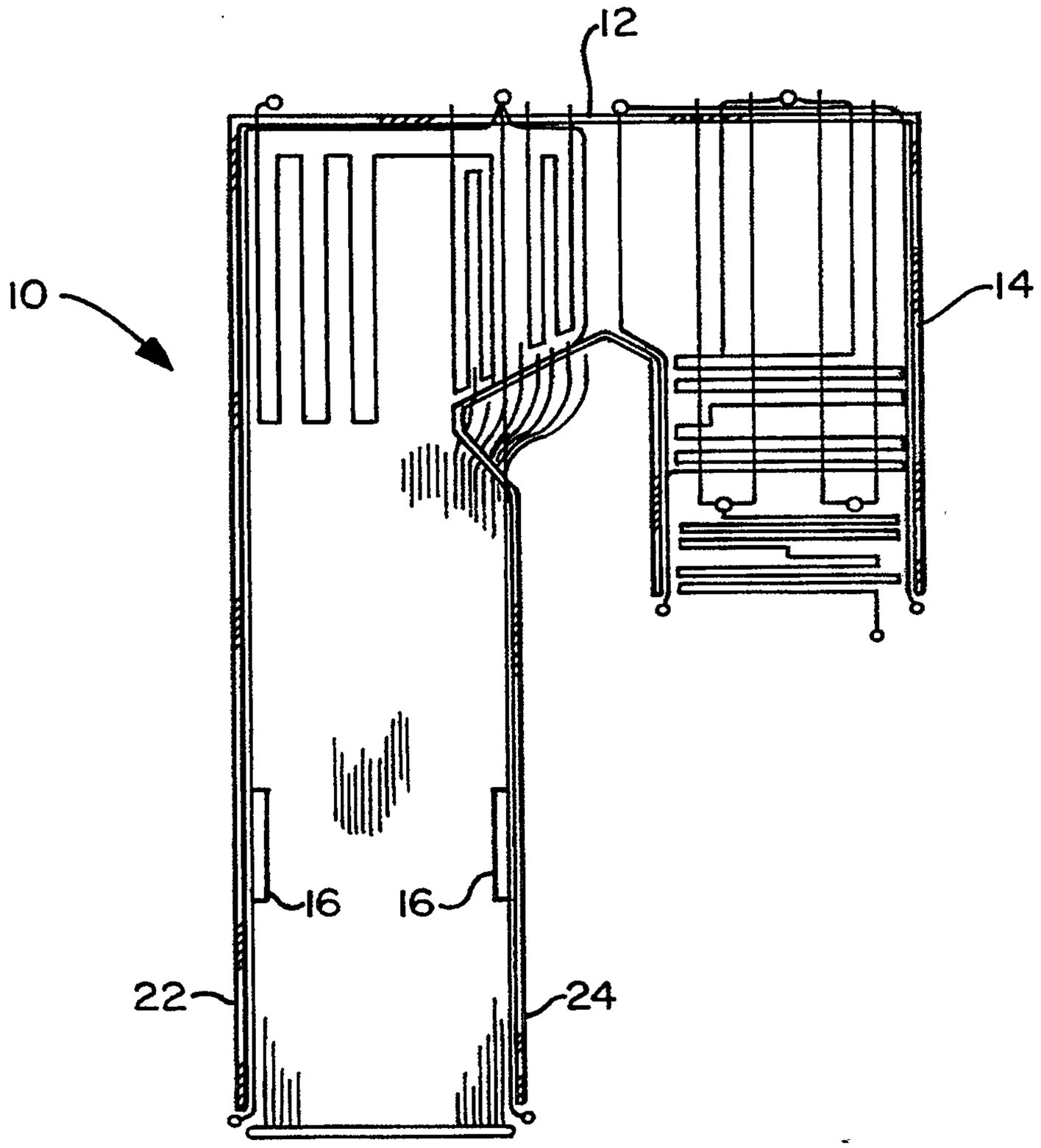


Fig. 1

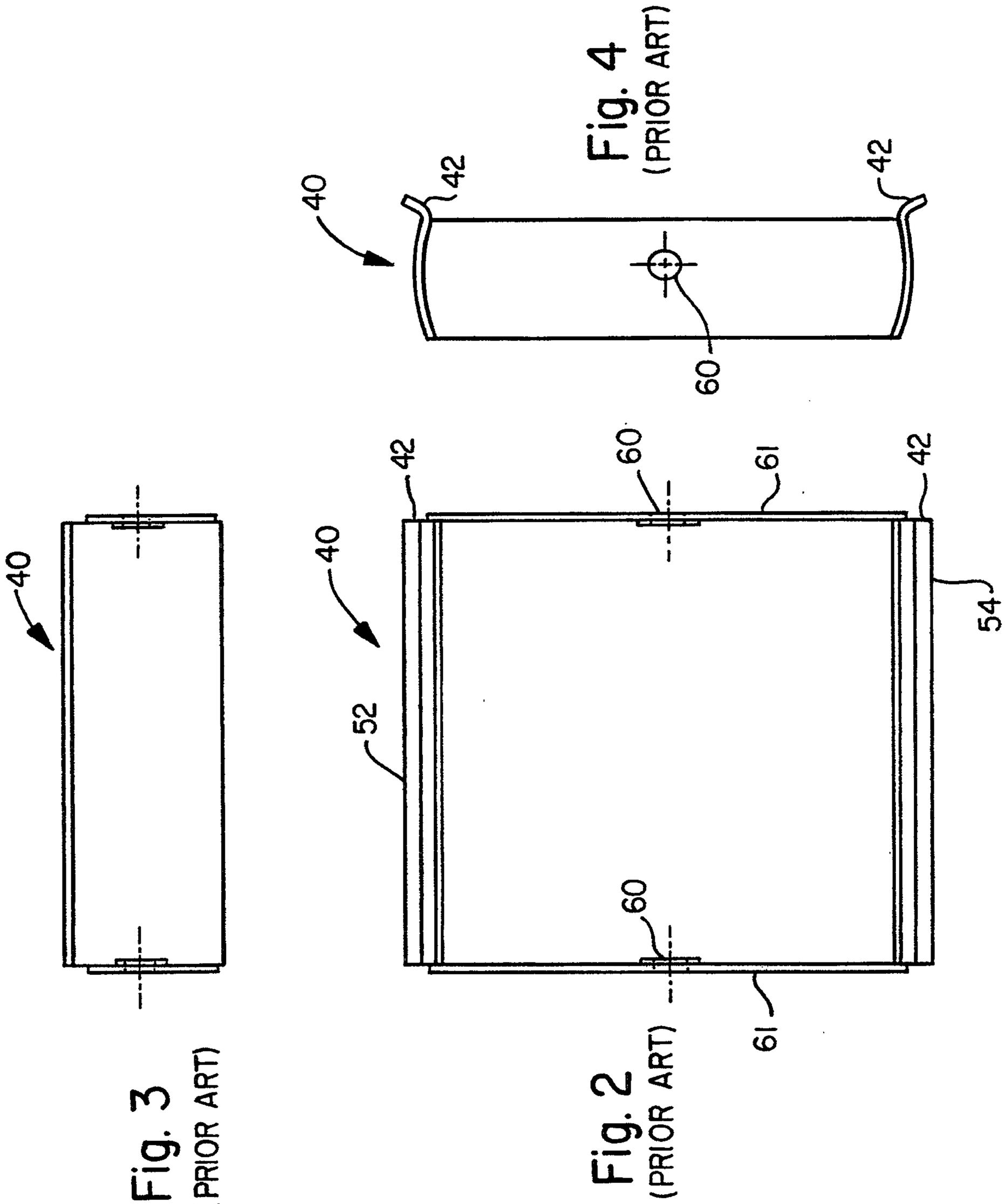


Fig. 4 (PRIOR ART)

Fig. 3 (PRIOR ART)

Fig. 2 (PRIOR ART)

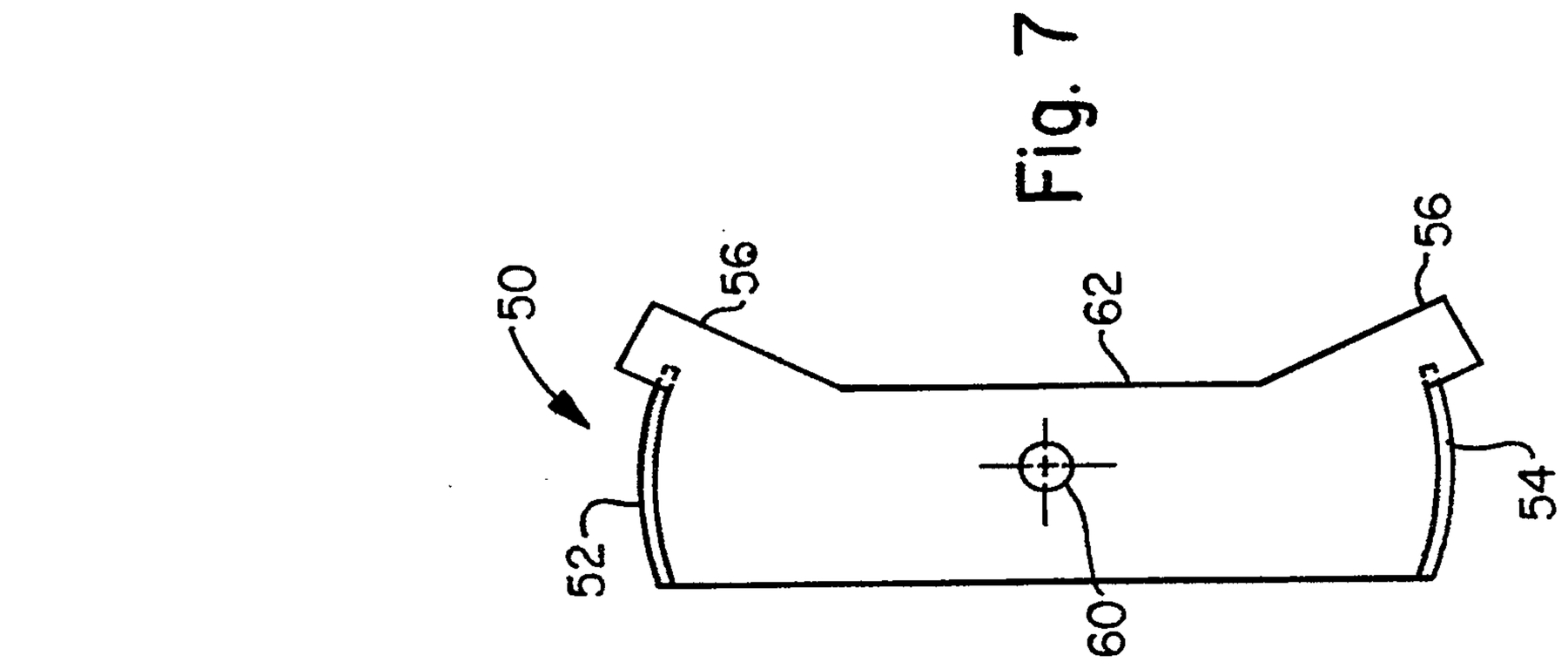


Fig. 7

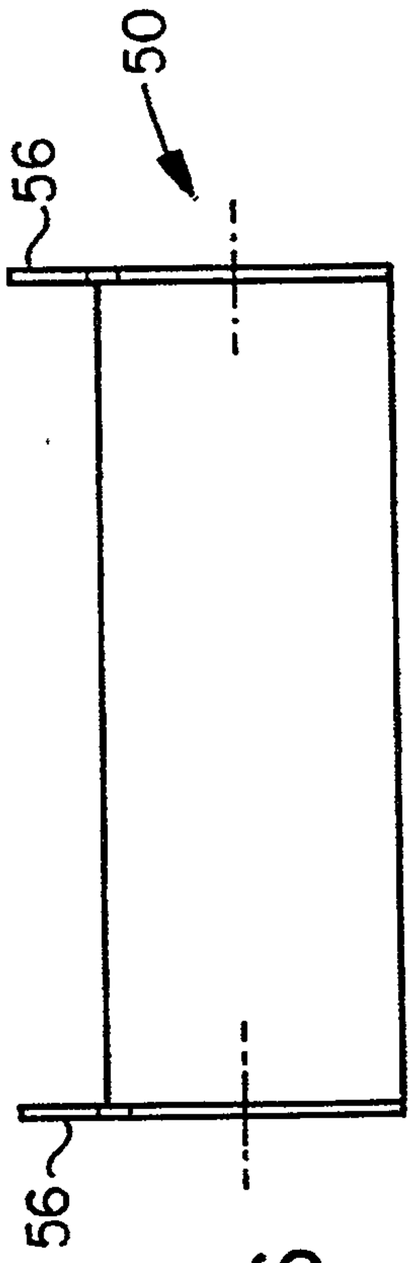


Fig. 6

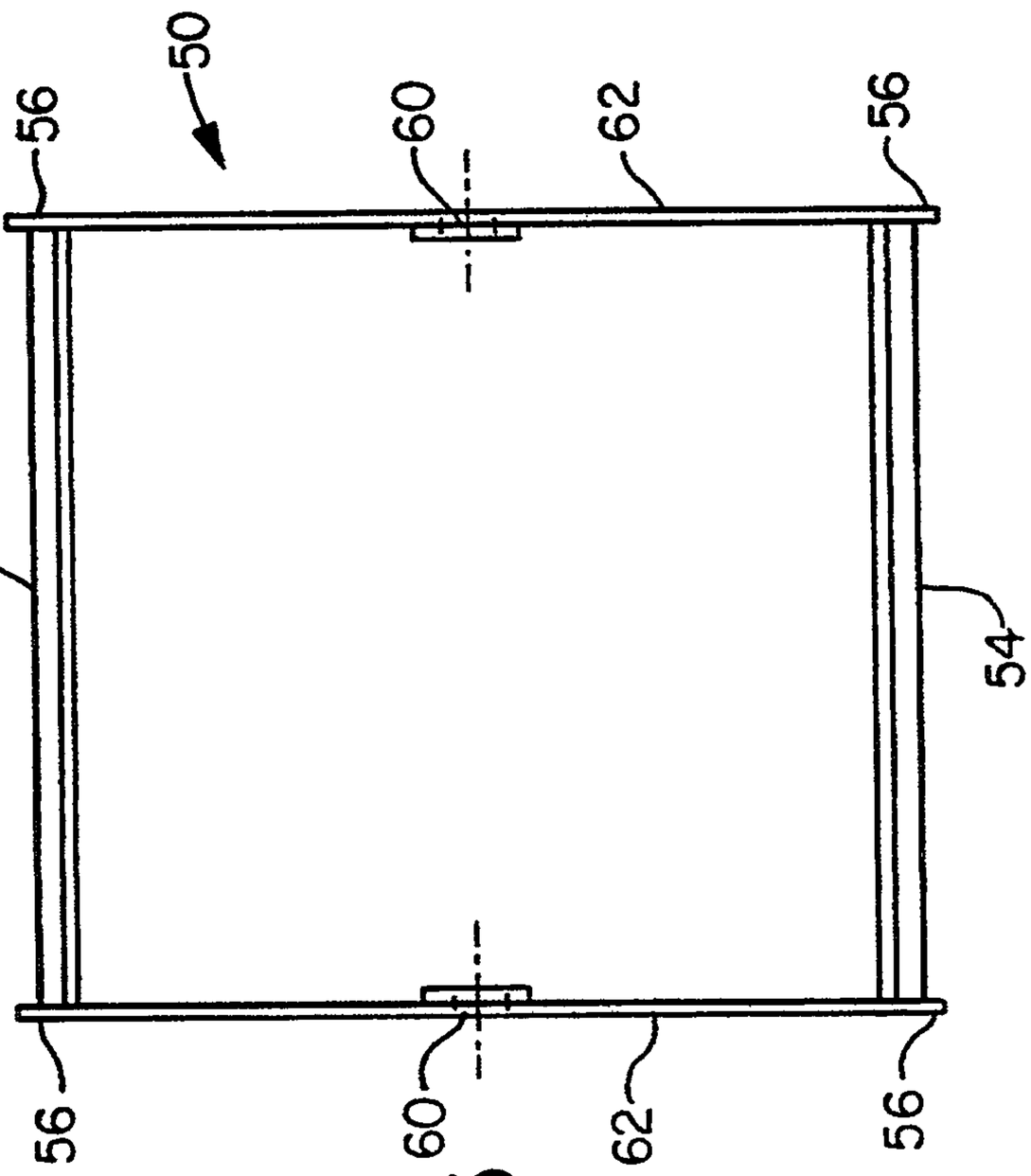


Fig. 5

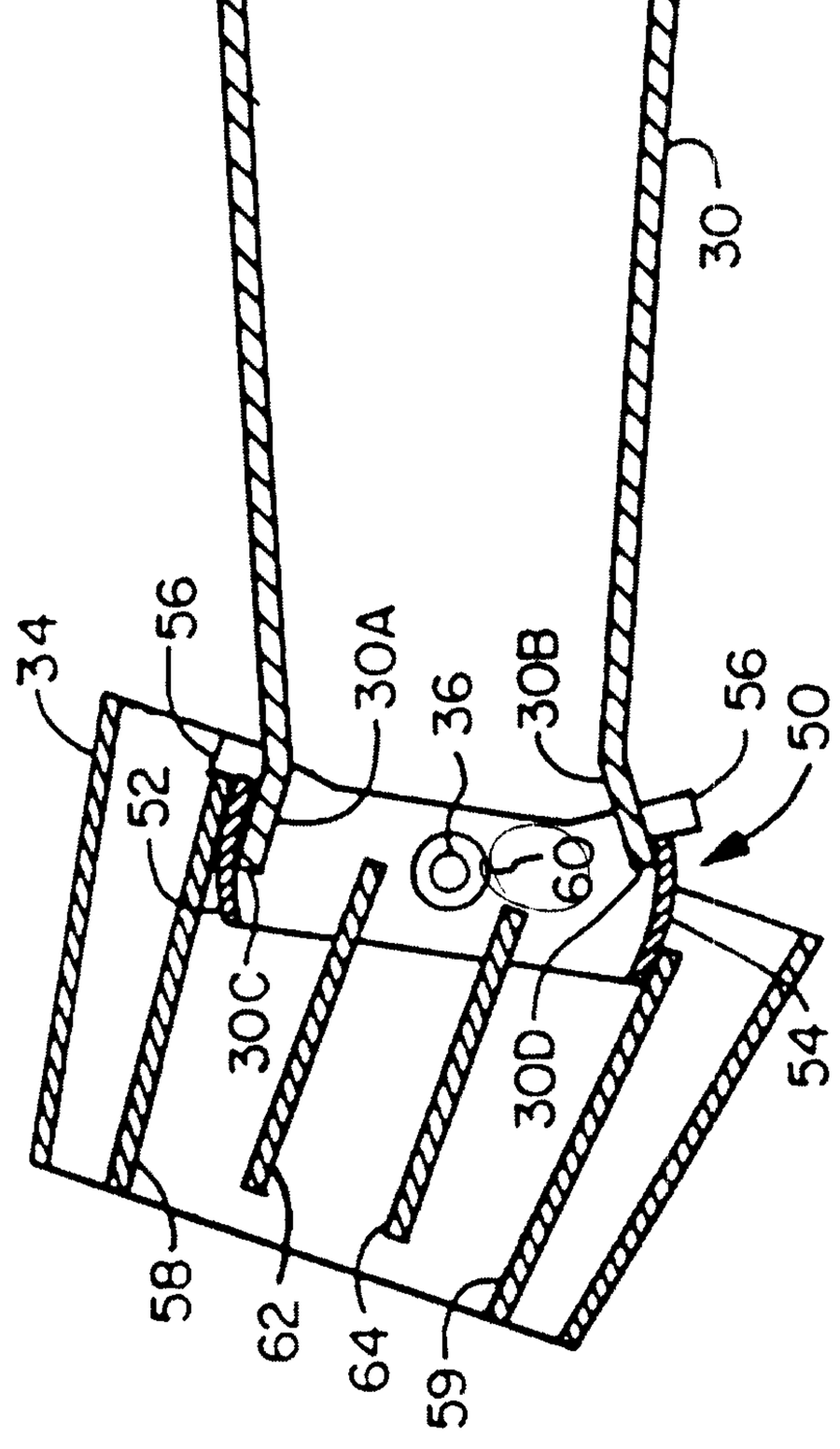

34
56
30A
36
30B
30
56
50
52
60
30C
30D
54
58
62
64
59

Fig. 8

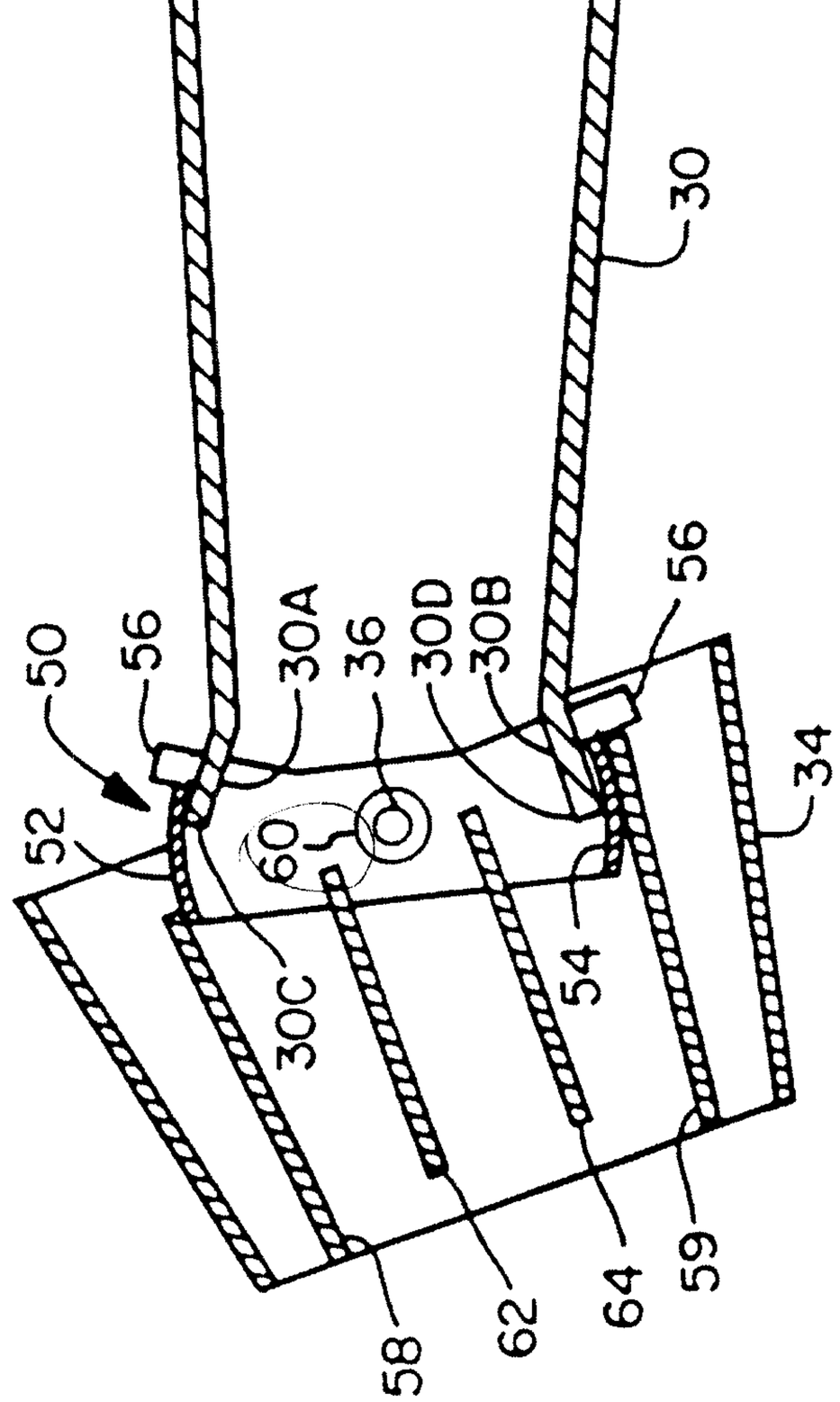
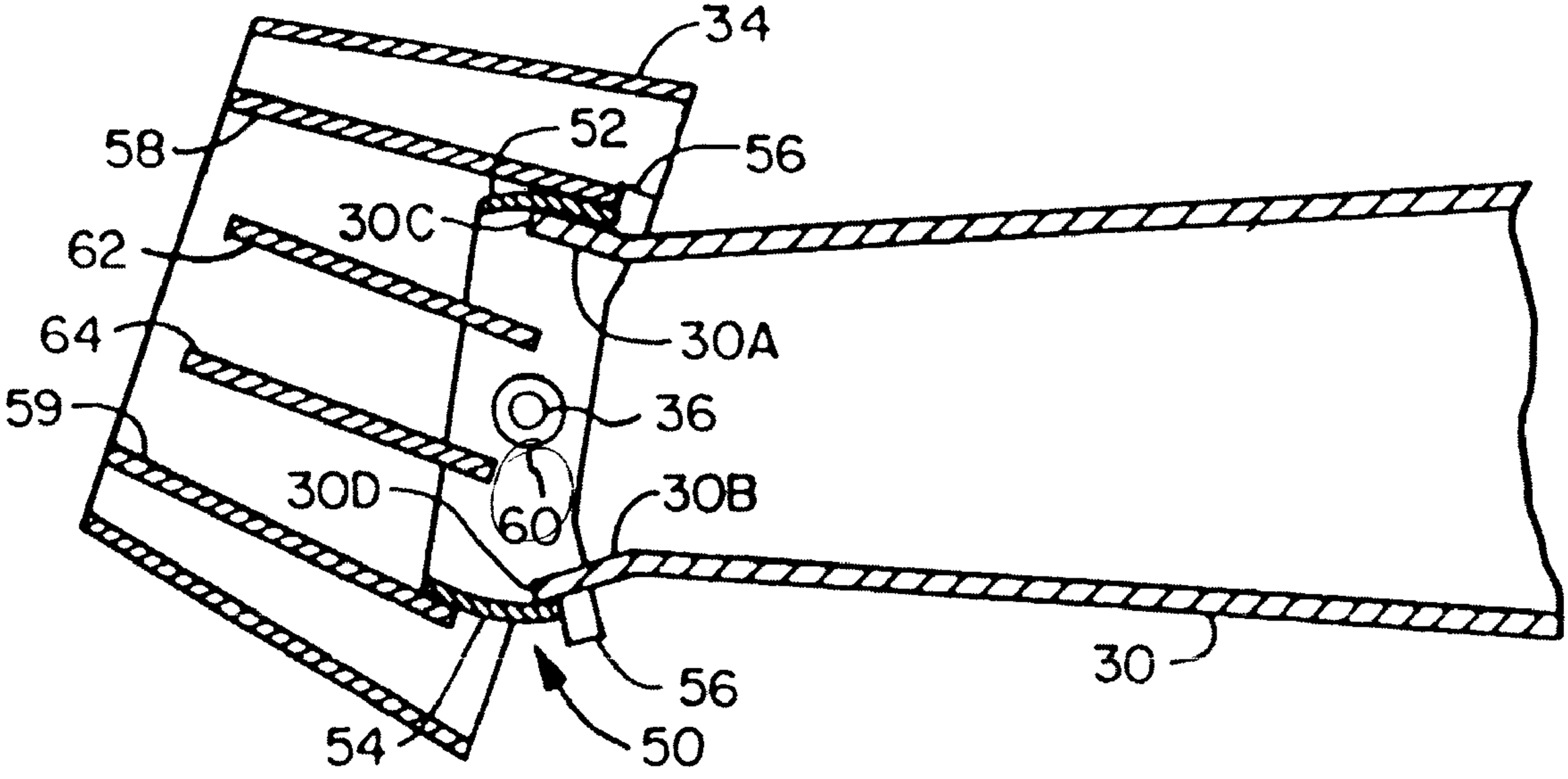

50
56
30A
36
30B
30
52
60
30C
54
34
58
62
64
59

Fig. 9


34
58
52
56
30C
62
64
30A
59
36
30D
60
30B
56
30
54
50